64. An apparatus for processing a substrate, comprising:

a particle measuring device for measuring particles on the substrate;

an apply tool for applying a film on the substrate;

a device that automatically selects parameters for cleaning the substrate based on information about the particles obtained by the particle measuring device; and

a substrate cleaning tool for cleaning the substrate with the parameters so selected.

Remarks

Claims 2-19, 29-32, 34, and 37-64 are pending in the application. Claims 1, 20-28, 33, 35, and 36 have been canceled. Claims 37-64 have been added. No new matter has been added by virtue of this amendment. Consideration of the application as amended is requested. If there are any questions please call applicant's attorney at 802 864-1575.

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29. (Amended) A method for [cleaning a wafer surface and the like and] removing [contaminant] particles [therefrom] from a surface of a substrate, comprising the steps of:

a) applying a film of sacrificial material to the [wafer] surface;[,]

b) locating said [contaminant] particles on said [wafer] surface and recording [the] coordinates of each particle [in a record,]; and

c) [providing laser means adapted for selectively exposing said wafer surface to laser light] shining light at said coordinates [of each particle, and]

d) selectively exposing said film and said wafer surface to light from said laser] to selectively remove particles whose coordinates were recorded [in said record].

30. [A] The method as recited in claim 29, further comprising the step of[:e)] providing a flow of an inert gas across said [wafer] surface while performing said [selectively exposing step (d)] shining step (c).

31. [A] The method as recited in claim 29, further comprising the step of[:f)] comparing said coordinates recorded in locating step (b) with device design data for identifying particles causing defects critical to device operation.

32. [A] The method as recited in claim 31 wherein said [laser] light is selectively applied only at said coordinates of said defects critical to device operation and expected to affect device yield.

34. An [improved semiconductor wafer processing] apparatus [for cleaning a wafer surface and the like and removing contaminant particles therefrom, said apparatus] comprising:

[a) a first station including means] an apply tool for applying a layer of sacrificial material to [said wafer] a substrate surface[,];

[b) a second station including means for] a measuring tool for locating [said contaminant] particles on said [wafer] surface and recording [the] coordinates of [each particle] said particles [in a record and means for transmitting said record,]; and

[c) a third station including

i) means for receiving said record from said second station,

ii) laser means adapted for] a light for selectively exposing said [wafer] surface [to laser light] at said recorded coordinates [of each particle according to said record, and

iii) means for providing a flow of vapor or gas across said wafer surface].

Please add the following new claims:

37. A method of processing a substrate comprising the steps of:

a) providing a substrate comprising patterns for electronic circuitry;

b) providing a liquid film on the substrate and drying solvent in the liquid to provide a dried unpatterned sacrificial film on the substrate;

c) transferring energy to physically remove said dried unpatterned sacrificial film from the substrate, wherein removing said film facilitates cleaning particles from the substrate.

38. The method as recited in claim 37, wherein said dried material comprises an organic material.

39. The method as recited in claim 38, wherein said dried organic material comprises resist or collodion.

40. The method as recited in claim 37, wherein said transferring energy step (c) comprises irradiating said film with light.

41. The method as recited in claim 40, wherein said irradiating said film with light step comprises shining a laser on said film

42. The method as recited in claim 41, wherein said laser comprises pulsed UV laser.

43. The method as recited in claim 37, further comprising the step of measuring particles on the substrate before said step (b) of applying said sacrificial film.

44. The method as recited in claim 43, wherein said measurement step (a) comprises computer software defect classification.

45. The method as recited in claim 44, wherein said measurement step (a) comprises auto defect classification.

46. The method as recited in claim 43, wherein said measurement provides type, composition, density, or position of particles on the substrate.

47. The method as recited in claim 46, wherein said composition measurement comprises analyzing exhaust gas after cleaning particles from the substrate.

48. The method as recited in claim 46, wherein said composition measurement comprises x-ray dispersive spectroscopy of particles on the substrate.

49. The method as recited in claim 43, further comprising the step of selecting a parameter of said providing step (b) or of said transferring energy step (c) based on data from said measuring particles on the substrate step.

50. The method as recited in claim 49, wherein said selecting a parameter step comprises selecting a parameter based on type of particle or composition of particle.

51. The method as recited in claim 50, wherein said selecting a parameter step comprises selecting a wavelength that is higher than that required to break bonds.

52. The method as recited in claim 43, wherein said measurement step comprises providing a map of particles on the substrate.

53. The method as recited in claim 43, wherein said transferring energy step (c) comprises aiming a beam at locations found in said measuring step.

54. The method as recited in claim 53, wherein said beam comprises a laser beam and wherein said method further comprises the step of selecting a recipe of said laser cleaning step based on data from said measuring particles on the substrate step.

55. The method as recited in claim 54, wherein said method further comprises the step of setting said laser with a generic recipe for cleaning major defects found in said measuring step.

56. The method as recited in claim 54, wherein said recipe is selected for each specific type of particle characterized in said measuring step and wherein said selective laser cleaning is directed to locations on the wafer where specific particles are actually located as determined in said measuring step.

57. The method as recited in claim 43, further comprising the step of storing said measurement in a data record for the substrate.

58. The method as recited in claim 43, further comprising the step of providing a second measurement of particles on the substrate after said cleaning step (c).

59. The method as recited in claim 58, further comprising the step of providing a second cleaning step if particles are found in said second measurement step.

60. The method as recited in claim 37, wherein in said providing a substrate step (a) said substrate is provided after a step in a process flow of fabricating the electronic

circuitry on the substrate but before other fabrication steps are complete.

61. The method as recited in claim 37, wherein said transferring energy step (c) comprises an area cleaning.

62. The method as recited in claim 61, wherein said area cleaning is proved by providing a laser beam and scanning said laser beam or by scanning said substrate with respect to said laser beam.

63. The method as recited in claim 37, wherein the substrate comprises a semiconductor wafer or a mask.

CLAIMS

1. A method for cleaning a wafer and the like and removing particles therefrom, comprising the steps of:

a) applying a film of sacrificial material to the wafer, and

b) exposing said film to light from a laser to remove said sacrificial material and said particles.

2. A method as in claim 1, wherein said step of applying said film of sacrificial material comprises applying said film to an effective thickness for removal of said particles.

3. A method as in claim 1, said particles having a size distribution ranging from a smallest diameter to a largest diameter, wherein said step of applying said film of sacrificial material comprises applying said film to a thickness between one-tenth of said smallest diameter and twice said largest diameter.

4. A method as in claim 1, wherein said step of applying said film of sacrificial material is performed by spraying a solution onto said wafer.

5. A method as in claim 1, wherein said step of applying said film of sacrificial material is performed by spinning a solution onto said wafer.

6. A method as in claim 1, further comprising the step of drying said film of sacrificial material before performing said exposing step.

7 8. A method as in claim 1, wherein said step of applying said film of sacrificial material comprises applying a quantity of nitrocellulose.

8 9. A method as in claim 1, wherein said step of applying said film of sacrificial material comprises applying a solution of soluble nitrocellulose in a mixture of alcohol and ether.

9 10. A method as in claim 1, wherein said step of applying said film of sacrificial material comprises applying a quantity of pyroxylin.

10 11. A method as in claim 1, wherein said step of applying said film of sacrificial material comprises applying a quantity of collodion.

12. A method as in claim 1, wherein said exposing step is performed by exposing said film to light from an excimer laser having an effective wavelength for removing said sacrificial film.

13. A method as in claim 12 wherein said sacrificial film is collodion and said effective wavelength is between about 150 and about 400 nanometers.

14. A method as in claim 12 wherein said light from said excimer laser irradiates said wafer at less than about 100 millijoules per square centimeter.

15. A method as in claim 1, further comprising the step of providing a flow of vapor across said wafer while performing said exposing step.

16. A method as in claim 15, wherein said flow of vapor is laminar flow.

17. A method as in claim 1, further comprising the step of providing a flow of an inert gas across said wafer while performing said exposing step.

18. A method as in claim 17, wherein said inert gas is selected from the list consisting of nitrogen and argon.

19. A method as in claim 17, wherein said flow of an inert gas is laminar flow.

20. A method for cleaning a wafer and the like and removing particles therefrom, comprising the steps of:

a) applying a film of sacrificial material to the wafer, said sacrificial film comprising collodion,

b) exposing said film to light from a laser emitting light having an effective wavelength, and

c) providing a flow of an inert gas across said wafer while performing said exposing step (b) to remove said sacrificial material and said particles.

21. A method as in claim 20, wherein said sacrificial film is applied as a solution of collodion in a solvent, said method further comprising the step of:

d) removing said solvent from said sacrificial film to form a dry collodion film.

22. A method as in claim 20 wherein said effective wavelength of said light is between about 150 and about 400 nanometers.

23. A method as in claim 20 wherein said light from said laser irradiates said wafer at less than about 100 millijoules per square centimeter.

24. An improved semiconductor wafer processing apparatus for cleaning a wafer surface and the like and removing particles therefrom, said apparatus comprising:

a) means for applying a layer of sacrificial material to said wafer surface,

b) a laser for exposing said wafer to a photon flux effective for removing said sacrificial material and said particles, and

c) means for providing a flow of vapor or gas across said wafer surface.

25. An improved semiconductor wafer processing apparatus as in claim 24, wherein said means for applying a layer of sacrificial material to said wafer surface is separated from said laser and from said means for providing a flow of vapor or gas.

26. An improved semiconductor wafer processing apparatus as in claim 24, further comprising:

d) means for transferring a plurality of semiconductor wafers among a plurality of processing stations under program control and for creating and maintaining a data record for each wafer indicating processing results at each processing station, and

e) means for transferring of cleaned wafers to an output station.

27. A method for cleaning a wafer surface and the like comprising the steps of:

a) locating contaminant particles on said wafer surface and recording the coordinates of each particle in a record,

b) providing laser means adapted for selectively exposing said wafer surface to laser light at said coordinates of each particle according to said record,

c) exposing said wafer to light from said laser to selectively remove particles whose coordinates were recorded in said record.

28. A method for cleaning a wafer surface and the like as in claim 27, further comprising the step of:

d) applying a film of sacrificial material to said wafer surface before performing said locating step (a).